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**PRODUCT IMPROVEMENT PROGRAM FOR THE M577
FUZE--VOLUME 3, REDESIGN
OF SETTING MECHANISM**

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The objective of this task was to redesign the setting mechanism for the M577 fuze in order to lower the cost. The proposed design replaces the dowel pins and stake used to secure the setting ring gears with two tabs die cast as part of the no. 1 plate. This design depends on the successful completion of the timer redesign product improvement program.		

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INTRODUCTION

The objective of this task was to optimize the design of the setting gear and pinion assembly and the timer setting ring gear assembly. In the present design, the setting gears and setting ring gear assembly consists of multiple laminae. This task investigated the possibility of reducing the number of laminae, thus, reducing the component cost and assembly time. In addition, reducing the cost of the setting ring gear assembly by eliminating the dowel pins was pursued.

Adherence to the functional and accuracy requirements of the setting mechanism was mandatory. The setting mechanism sees a maximum torque of 14 inch pounds; the maximum allowable torque of the slip clutch mechanism. Using this as a guide, it was decided that all components of the setting mechanism had to withstand 20 inch pounds of torque without excessive yielding for any proposed design change to be acceptable.

DISCUSSION

An investigation was conducted to determine whether one of the laminae in the setting ring gear assembly or setting gears could be eliminated. A specially designed test fixture was built to statically test the setting mechanism.

Single lamina setting gears were staked to setting pinions and assembled into timer housing assemblies. These timer housing assemblies were statically tested with standard plate no. 1 assemblies in the static test fixture. The single lamina setting gears failed at approximately 55 inch pound torque when three of the teeth broke. Fuzes were built with single lamina setting gears and tested by setting to 200 seconds and back ten times. The change in the zero set was measured after the test and found to be satisfactory. As the result of another product improvement program contract, the setting shaft was changed from stainless steel to aluminum. The 200 second setting test using one lamina setting gear was repeated with an aluminum setting shaft. The aluminum setting shaft did not survive the test. The one lamina setting gear cut a groove in the aluminum setting shaft and the setting mechanism failed when the fuze was repeatedly set to 200 seconds and back. Since the aluminum setting shaft offered a greater cost savings than the elimination of a setting gear lamina, the one lamina setting gear was dropped from further consideration.

Setting ring gear assemblies with one lamina of .030 in. were installed in timer no. 1 plate assemblies and statically torque tested. The single lamina ring gear failed at approximately 20 inch pounds torque when two teeth were severely distorted. Examination of the setting mechanism after testing showed fracture also occurred on the setting gear pinion teeth. The possibility of using a single .030 in. stainless steel setting ring gear was abandoned.

It was decided to investigate using beryllium copper alloy 172 for the setting ring gear. Since this material can be easily stamped and then heat treated, a thicker than .030 in. gear can be used. The setting mechanism with a .040 in. single lamina beryllium copper alloy was tested and shown to be technically acceptable. However, the manufacturing cost for one lamina beryllium copper is greater than the current design because of the high material cost and the added cost of heat treating.

The possibility of eliminating the two dowel pins in the setting ring gear was investigated. Yield and ultimate strength tests were performed to determine the torque required to move the setting ring gears in the no. 1 plate with and without the dowel pins. The stake holding the setting ring gear in the no. 1 plate broke at significantly less torque without the dowel pins than with the dowel pins. Eliminating the dowel pins with no other design change is, therefore, not acceptable.

Alternate designs to the dowel pins and current stake for holding the setting ring gears were explored. Another product improvement program contract redesigned the timer no.1 plate as an aluminum die casting. The concept of using keys in the no. 1 plate to position and hold the setting ring gears instead of dowel pins and the current stake was tried. Prototypes of the no. 1 plate with various size keys were made and tested. The optimum key size was determined, and die cast no. 1 plates with two keys were ordered as part of the timer redesign contract.

Yield tests on the setting mechanism, using an aluminum die cast no. 1 plate with two keys, were performed, and the results were compared to the standard setting mechanism. At ten inch pounds of torque the redesigned no.1 plate and setting ring gear showed less yield than the standard setting mechanism. The keys in the no. 1 plate prevent the setting ring gears from rotating, but a technique was still needed to keep the setting ring gear seated in the no. 1 plate. Various tools to crimp the no. 1 plate over the setting ring gear were tried. In order to prevent the die cast no. 1 plate from cracking, a 360° roll crimp was used to hold the setting ring gears in place. A pin that fits in the setback pin hole of the setting ring gear will be placed in the assembly tool to align the teeth of the two laminae of the setting ring gears when being assembled.

Units with a die cast no. 1 plate with two tabs and two .030 in. setting ring gears were built and ballistically tested with satisfactory results. No problems were observed in setting the fuzes. The results of the ballistic test are given below.

Lot #HAT82D000E087 - Test Units

<u>Gun</u>	<u>Zone</u>	<u>Environ- ment (°F)</u>	<u>Time (sec.)</u>	<u>Function</u>	<u>Mean</u>	<u>Std. Dev.</u>
105mm, M204	8	70	75	15/15	75.153	.116
105mm, M103	7	145	50	20/20	50.115	.068

Lot #HAT82D000E088 - Control Units

105mm, M204	8	70	75	15/15	75.160	.144
105mm, M103	7	145	50	19/20	50.130	.091

Additional ballistic testing of the die cast no. 1 plate assembly with the two keys to hold the setting ring gear was performed as part of the timer redesign product improvement contract. The results of these tests and the cost savings will be reported as part of the timer redesign product improvement program.

CONCLUSION

The concept of replacing the dowel pins and stake to hold the setting ring gear with two tabs in the die cast no. 1 plate is feasible. However, this concept is dependent on using a die cast no. 1 plate, which is part of the timer redesign. Therefore, acceptance of this design depends on the outcome of the timer redesign, which has been tested with satisfactory results. However, additional units must be tested before final acceptance.

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